REMARKS

The last Office Action in the above-identified application and the references cited by the Examiner have been carefully considered. The claims have been amended in a sincere effort to define more clearly and specifically features of Applicants' invention which distinguish over the art of record.

Claims 1-3 have been rejected under 35 U.S.C. §102(b) as being anticipated by Japanese Patent Publication No. 03-068201 (Kawabata Kazuya), which Applicants brought to the attention of the Patent and Trademark Office in an Information Disclosure Statement. Furthermore, Claims 1, 3 and 4 have been rejected under 35 U.S.C. §102(b) as being anticipated by Japanese Patent Publication No. 2002-217638 (Fukui Takahito). The Fukui Takahito Japanese document was also cited to the Patent and Trademark Office by Applicants in an Information Disclosure Statement.

In addition, Claims 1 and 3 have been rejected under 35 U.S.C. §102(b) as being anticipated by Japanese Patent Publication No. 06-069717 (Fujimoto Kyohei), which was also cited by Applicants to the Patent and Trademark Office in an Information Disclosure Statement.

Furthermore, Claims 5 and 7-9 have been rejected under 35 U.S.C. §103(a) as being unpatentable in view of the combination of Japanese Patent Publication No. 05-121925 (Yabe Takakiyo) and any one of the Kawabata Kazuya, the Fukui Takahito or the Fujimoto Kyohei publications.

Additionally, Claims 6 and 10-13 have rejected under 35 U.S.C. §103(a) as being unpatentable in view of Japanese Patent Publication No. 2002-171190 (Kuriyama Toshihide), also cited by Applicants in an Information Disclosure Statement to the Patent and Trademark Office, in combination with any one of the Kawabata Kazuya, the Fukui Takahito or the Fujimoto Kyohei Japanese references.

The comments of the Examiner with respect to his reasons for rejecting Claims 1-13 found on Pages 2-4 of the Office Action are acknowledged and gratefully appreciated. Main

apparatus Claim 1 has been amended, and new Claims 14-16 have been added, in a sincere effort to define more clearly and more specifically features of Applicants' invention which distinguish over the art of record.

The claimed invention is directed to a patch antenna exhibiting asymmetrical directivity and further being reducible in size. As stated in the specification of the subject application and defined by independent Claim 1, the patch antenna includes a dielectric substrate 12, a ground conductor 18 and a patch conductor 14 wherein the radiation efficiency is changed in a direction of wavelength-dependent length of the patch conductor 14. The aforementioned reference numbers are added herein to facilitate the Examiner's understanding of the invention with reference to the embodiments of the invention disclosed in the specification and shown in the drawings, and should not be construed as limiting the scope of the claims in any way. As is further stated in the specification, to achieve asymmetrical directivity in order to reduce the influence of coupling with the human body, the radiation efficiency of the antenna is altered to provide a radiation pattern that is asymmetrically directional. One means of altering the radiation efficiency comprises a step 16 within the dielectric substrate 12. The step 16, positioned closer to one end of the patch antenna 10, but still under the patch conductor 14, causes the spacing between the patch conductor 14 and the ground conductor 18 to become non-uniform. More specifically, the specification of the subject application makes reference to Figure 2 which shows spacings G1 and G2, each being defined as the space between the patch conductor 14 and ground conductor 18, in which spacing G1 is greater than spacing G2. Since spacings G1 and G2 differ, the thickness of the dielectric substrate 12 is thus non-uniform in the direction of the wavelength-dependent length of the patch conductor 14. When the thickness of the substrate is discontinuous or non-uniform, it can be seen that the radiation efficiency varies depending on the thickness of the substrate, as shown in Figure 3, and the antenna exhibits asymmetrical directivity. What is described above is but one of several examples disclosed in the application of varying the radiation efficiency in a patch antenna in the direction of the wavelength-dependent length of the patch conductor.

The Kazuya Japanese publication was brought to the attention of the Patent and Trademark Office in an Information Disclosure Statement filed concurrently with the

application. The Kazuya published application discloses a dielectric antenna having a radiation electrode 12 and a curved ground electrode 14 provided on one main face 11 of a dielectric body 10, the dielectric antenna having a directional pattern for wide range. Applicants were unable to obtain a full English translation of the Kazuya Japanese publication, but respectfully refer the Examiner to the English abstract (Patent Abstracts of Japan) which was submitted with the earlier-filed Information Disclosure Statement.

More specifically, and as described in the Kazuya published application, and initially making reference to Figure 1 thereof, the dielectric antenna includes a curved ground electrode 14 that concavely intrudes into a dielectric body 10. The intrusion of the ground electrode 14 into the dielectric body 10 alters the distance between the radiation electrode 12 and the ground electrode 14, and in a specific region, decreases the thickness of the dielectric body 10. Additionally, making reference to Figure 8 of the Kazuya reference, in a second embodiment, the curved ground electrode 14 may be convexly formed, increasing the distance between the radiation electrode 12 and the ground electrode 14. However, although the thickness is varied and thus creates a non-uniform dielectric body, it can be seen from Figures 1, 2, 3 and 8 of the Kazuya published application that the variation in the ground electrode, whether concave or convex in formation, is symmetrical in shape and symmetrically located relative to its overall position in the dielectric antenna and under the radiation electrode 12. As such, while the thickness of the substrate is non-uniform, it is symmetrically non-uniform. Thus, as can be seen in Figures 3 and 8 of the Kazuya publication, the radiation efficiency or radiation pattern, while directional, is in fact symmetric.

Claim 1 defines Applicants' patch antenna as having a dielectric substrate, a ground conductor and a patch conductor, wherein the radiation efficiency is changed in a direction of its wavelength-dependent length. The Kazuya dielectric antenna structurally includes a radiation electrode (which the Examiner equates to the patch conductor in Claim 1), a dielectric body (which the Examiner equates to the dielectric substrate) and a ground electrode (which the Examiner equates to the ground conductor). Additionally, the field pattern in the Kazuya dielectric antenna (which the Examiner believes corresponds to radiation efficiency) does change across the antenna based upon the varying distances

between the ground electrode and radiation electrode; however, it does so symmetrically across the entire length of the antenna, not asymmetrically as in the claimed invention.

More specifically, it should be noted that in the Kazuya reference, and as shown in Figures 1, 2, 3 and 8 thereof, the concave or convex formation of the ground electrode is symmetric in shape and symmetrically located lengthwise within the dielectric antenna with respect to the radiation electrode, which means that the field pattern or radiation efficiency is also symmetric. The radiation pattern can be seen in Figures 3 and 8 of the Kazuya reference, as mentioned previously.

This is not the case with Applicants' claimed patch antenna and the radiation efficiency thereof. The position of the step (or other non-uniformity in its structure), which alters the distance between the ground conductor and the patch conductor (or the dielectric thickness or constant) is asymmetrically positioned under the patch conductor 14 in closer proximity to one end of the patch antenna, and is not centered under and symmetric with respect to the patch conductor. As such, and as specifically disclosed in the specification, the radiation efficiency of Applicants' patch antenna is altered in the direction of wavelength-dependent length of the patch conductor and the antenna exhibits an asymmetrical radiation pattern in such direction.

Accordingly, Applicants have amended Claim 1 to more specifically define the patch antenna as exhibiting a radiation pattern which is asymmetric along the length of the antenna to further distinguish the claimed invention over the Kazuya reference.

The Examiner is now kindly requested to refer to the Takahito, et al. published application, and in particular, Figures 4-9 thereof. Applicants were now able to obtain a computerized English translation of the Takahito, et al. publication, and have enclosed a copy of the translation for the Examiner's reference. The Takahito, et al. reference discloses an antenna unit having a radiating element 1 and dielectric layer 2, both of which are sequentially layered on a conductive layer 3. In an additional embodiment, the Takahito, et al. antenna unit may further include a dielectric film 4 and subsequent dielectric layers 21-24, the addition of which may function to regulate the beam width of the antenna unit.

As described in the Takahito, et al. publication, and initially making reference to Figure 1 thereof, the antenna unit in a first embodiment includes, sequentially, a radio emission element 1, a dielectric film 4, a dielectric layer 2 and a conductive layer 3. Now referencing Figures 4-11 of the Takahito, et al. published application, it can be seen that additional dielectric layers 21-24, dielectric films 4 and 41 and radio emission elements 11 may be added to regulate the beam width of the antenna unit. The addition of the layers allegedly changes the overall inductive capacity of the antenna unit, thus regulating the beam width. As stated in paragraph [0014] of the English translation, by varying the thickness of a dielectric layer 2 by including a gaseous-phase section S, the effective thickness can be changed and the beam width can be made large. Now making reference to paragraph [0015] and Figure 4 of the Takahito, et al. publication, an additional dielectric layer 21 and film 4 may be added to the antenna unit to increase the inductive capacity and decrease the beam width. Furthermore, by decreasing the inductive capacity and removing layers, the publication states that the beam width may be made larger.

It should be noted that in no portion of the translated specification or drawings of the Takahito, et al. reference is it stated or implied that the beam pattern is symmetrical or asymmetrical. However, from an analysis of the drawings of the Takahito, et al reference, it can be seen that the sandwiching technique used creates a symmetric structure which in turn Applicants believe would yield a symmetric radiation beam.

Therefore, amended Claim 1 which now more specifically defines the patch antenna radiation pattern as being asymmetric along the length of the antenna is respectfully urged to further distinguish the claimed invention from the Takahito, et al. published application.

The Examiner's attention is now respectfully called to the Kyohei, et al. publication, and in particular, Figure 1 thereof. Applicants were also now able to obtain a computerized English translation of the Kyohei, et al. publication, and a copy of such is submitted herewith for the Examiner's reference.

The Kyohei, et al. reference discloses an oblique two-layer dielectric constitution microstrip antenna having a first dielectric 4, second dielectric 5 and ground plate 2. The first and second dielectrics 4, 5 are slanted and angled together to maintain a constant thickness

across the microstrip antenna and shorten the length of the antenna while allegedly improving radiation efficiency and bandwidth.

More specifically, as described in the Kyohei, et al. reference, and initially referring to Figure 1 thereof, the microstrip antenna includes a first dielectric 4, second dielectric 5 and ground plate 2. The Kyohei, et al. published application specifically teaches the use of multiple dielectric bodies. Specifically, in paragraph [0018] of the translated specification, it is stated that the microstrip antenna achieves its operational goals by not using a single dielectric layer. The translated specification mentions in paragraph [0016] that the gain and radiation efficiency of the antenna are affected by the length of the antenna (please see Figures 6 and 7), but there does not appear to be any teaching or suggestion in the Kyohei, et al. reference to design the antenna such that it exhibits an asymmetric radiation pattern along the length of the antenna, as now defined by amended Claim 1.

Accordingly, it is respectfully urged that Claim 1, as now amended to more specifically define the patch antenna as exhibiting a radiation pattern which is asymmetric along the length of the antenna, patentably distinguishes over the references of record and is allowable.

Claims 2-13 depend directly or indirectly from amended Claim 1 and, accordingly, patentably distinguish over the references of record for the same reasons submitted with respect to amended Claim 1 and discussed previously.

The Examiner also contends that the combination of the Kazuya, Takahito, et al. and Kyohei, et al. published applications in view of the Takakiyo et al. reference discloses every feature of the invention set forth in Claims 5 and 7-9.

Applicants have now been able to obtain a computerized English translation of the Takakiyo, et al. reference, and are submitting herewith a copy of this translation for the Examiner's reference. The Examiner cites the Takakiyo, et al. document for showing a dielectric 15 used in a patch antenna as being loaded. It is believed that the Examiner is equating the dielectric 15 of the Takakiyo, et al. publication to Applicants' loaded dielectric 22, shown in Figure 14 of the subject application. However, like the other references cited by

the Examiner, the Takakiyo, et al. publication does not teach or suggest a patch antenna exhibiting a radiation pattern which is asymmetric along the length of the antenna, as now more specifically defined by amended Claim 1.

Lastly, the Examiner suggests that the combination of the Kazuya, Takahito, et al. and Kyohei, et al. published applications in view of the Toshihide, et al. published application discloses every feature of Applicants' invention set forth in Claims 6 and 10-13.

Applicants were not able to obtain a full translation of the Toshihide, et al. reference, and so kindly ask the Examiner to refer to the English abstract (Patent Abstracts of Japan) of the document submitted in the Information Disclosure Statement filed concurrently with the subject application.

Claims 6 and 10-13 of the subject application define a cellular telephone having a patch antenna defined by Claim 1. The Toshihide, et al. reference was cited by the Examiner for showing a cellular telephone incorporating patch antennas which have a higher radiation efficiency in a direction which is opposite to the side of the telephone housing on which the user places his or her head. However, there appears to be no disclosure in the Toshihide, et al. reference of how the patch antenna is made, and certainly no description in the Toshihide, et al. reference of the specific structure that is set forth in Claim 1 of the subject application. Furthermore, it appears from the drawings in the Toshihide, et al. published application and from the English abstract thereof that the two patch antennas used in the earpiece section and mouthpiece section of the foldable cellular telephone depicted therein may have nothing more than a reflector to reflect the antenna pattern to obtain asymmetrical directivity, such as disclosed in the "Prior Art" section of the subject application and found in the bridging paragraph between pages 1 and 2 of the filed application. Certainly, such structure would differ from that of Applicants' patch antenna defined by Claim 1, and would have the same shortcomings of the "patent document 1" identified in the subject application. Additionally, if one looks at the drawings of the Toshihide, et al. document, it can be clearly seen that each patch antenna exhibits a symmetric radiation pattern (along the length of the antenna), not an asymmetric radiation pattern, as defined by amended Claim 1. Therefore, Applicants

respectfully urge that Claims 6 and 10-13, which depend from amended Claim 1, patentably distinguish over the combination of the references which the Examiner cited.

Applicants further submit new Claims 14-16 for the Examiner's kind consideration. More specifically, new Claim 14, which depends from amended Claim 1, further defines the dielectric substrate as being a single dielectric substrate having a uniform dielectric constant.

With respect to new Claim 14, submitted for the Examiner's consideration, Applicants note that in the Kyohei, et al. reference, and as shown in Figure 1 and described in the English translation of the disclosure, the microstrip antenna specifically comprises at least two dielectric bodies. Additionally, the Kyohei, et al. publication does not appear to disclose an asymmetric radiation pattern.

As previously mentioned, amended Claim 1 more specifically defines the patch antenna as exhibiting a radiation pattern which is asymmetric along the length of the antenna, which further distinguishes the claimed invention from the Kyohei, et al. reference. New Claim 14, which depends from Claim 1, further limits the patch antenna of the subject application to a single dielectric substrate of a uniform dielectric constant, and is respectfully urged to even further distinguish Applicants' invention over the Kyohei, et al. reference.

New independent Claim 15 is directed to the specific structure of the patch antenna shown in Figures 1, 2, 7-9 and 11-14 of the subject application and defined by original Claim 3. Here, the dielectric substrate is defined as having a first thickness and a second thickness which are different from each other, and there is an abrupt step, such as at 16, in the thickness of the dielectric substrate. Claim 15 defines the abrupt step in thickness of the dielectric substrate as being situated in alignment with the patch conductor between the first and second ends of the patch conductor but offset from and in non-alignment with the center of the patch conductor. This is clearly shown in the drawings of the subject application. None of the references of record appears to disclose such structure.

New independent Claim 16 more specifically defines Applicants' patch antenna which is defined by original Claim 2, where the spacing between the patch conductor and ground conductor is made non-uniform, such as shown in Figure 2 of the subject application. In new

Claim 16, the patch conductor and the ground conductor are defined as being separated from each other by a first spacing, a second spacing situated adjacent the first spacing, and an abrupt change in the spacing situated between the first spacing and the second spacing. Claim 16 defines the abrupt change in spacing as being situated in alignment with the patch conductor between the first end and the second end of the patch conductor, and being offset from and in non-alignment with the center of the patch conductor. Again, this structure is clearly shown in the drawings of the subject application.

In each of new Claims 15 and 16, it is stated that the patch antenna exhibits a radiation pattern which is asymmetric along the length of the antenna due to either the abrupt step in thickness (Claim 15), or the abrupt change in spacing (Claim 16) of the dielectric substrate. None of the references of record discloses an abrupt step in thickness or an abrupt change in spacing of the dielectric substrate, as defined by Claims 15 and 16, and furthermore, none of the references of record discloses a patch antenna that exhibits a radiation pattern which is asymmetric along the length of the antenna, as also set forth in new Claims 15 and 16. Accordingly, it is respectfully urged that new Claims 14-16 patentably distinguish over the references of record and are allowable.

In view of the foregoing amendments and remarks, entry of new Claims 14-16 and the amendments to Claim 1, favorable reconsideration of Claims 1-13 and favorable consideration of new Claims 14-16 and allowance of the application with Claims 1-16 are respectfully solicited.

Respectfully submitted,

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